

TABLE 3.—Solar radiation intensities and atmospheric transmission coefficients at Fresno, Calif.

Date	Sun's zenith distance								
	0°	48° 3'	60° 0'	66° 5'	70° 7'	73° 6'	75° 7'	77° 4'	78° 7'
	Air mass								
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Solar radiation (Gram-calories per minute per square centimeter of normal surface)									
1928—A. M.									
Oct. 6	1.36								
Oct. 7	1.39	1.22	1.10	0.94	0.81				
Oct. 8	1.42	1.25	1.11	1.04	0.92				
Oct. 10				1.05					
Means	1.39	1.24	1.10	1.01	0.86				
1920									
Mar. 14	1.52	1.42	1.34	1.26	1.18	1.11	1.05	0.98	0.91
1928—P. M.									
Oct. 6		1.26	1.16	1.07	0.99	0.92	0.85		0.72
Oct. 7		1.28	1.17	1.10	1.03				
Oct. 8		1.29	1.20	1.13	1.01				
Means		1.28	1.18	1.10	1.01	0.92	0.85		0.72
1920									
Mar. 14		1.42	1.33	1.24	1.15	1.07	1.00	0.93	0.87
Atmospheric transmission									
A. M.—October	1.01			0.86					
	1.24	0.815		1.10	0.782				
March	1.26			1.18					
	1.42	0.887		1.34	0.881				
P. M.—October	1.10			1.01		0.72			
	1.28	0.859		1.18	0.856	0.85	0.847		
March	1.24			1.15		0.87			
	1.42	0.873		1.33	0.865	1.00	0.870		

POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. C. S. Freeman, Superintendent U. S. Naval Observatory. Data furnished by Naval Observatory, in cooperation with Harvard, Yerkes, and Mount Wilson Observatories. The differences of longitude are measured from central meridian, positive west. The north latitudes are plus. Areas are corrected for foreshortening and are expressed in millionths of sun's visible hemisphere. The total area, including spots and groups, is given for each day in the last column.]

Date	Eastern standard civil time	Heliographic			Area		Total area for each day
		Diff. long.	Longi- tude	Lati- tude	Spot	Group	
1929							
Jan. 1 (Mount Wilson)---	<i>h. m.</i> 14 5	°	°	°			
		-31.0	237.7	-11.0		28	
		-7.0	261.7	+15.0	4		
		0.0	268.7	-20.0		35	
		+3.0	271.7	+10.0		19	
		+23.0	291.7	+8.0		253	
		+40.0	308.7	+20.0		43	
		+60.0	323.7	+5.0		13	395
Jan. 2 (Naval Observa- tory).	11 40	-81.0	175.7	+12.0	201		
		-56.5	200.2	+11.5	9		
		-18.0	238.7	-9.5		46	
		+12.0	268.7	-19.0		77	
		+35.0	291.7	+8.5		340	
		+50.5	307.2	+21.5		62	735
Jan. 3 (Naval Observa- tory).	11 35	-67.0	176.6	+12.5		247	
		-5.5	238.1	-8.5	15		
		+25.6	269.1	-18.5		46	
		+33.5	277.1	+10.0	22		
		+49.5	293.1	+8.5		370	
		+63.5	307.1	+21.5		90	790
Jan. 4 (Naval Observa- tory).	11 39	-53.5	176.9	+12.5		185	
		-1.0	229.4	+10.5		12	
		+7.5	237.9	-9.0		22	
		+40.0	270.4	-17.0	28		
		+47.0	277.4	+9.0		77	
		+66.0	296.4	+9.0	185		
		+78.5	308.9	+22.5	31		540
Jan. 5 (Mount Wilson)---	16 00	-60.0	154.8	-14.0		7	
		-37.0	177.8	+12.0		212	
		-16.0	198.8	-13.0		7	
		+63.0	277.8	+9.0		37	
		+73.0	287.8	+7.0		84	347
Jan. 6 (Naval Observa- tory).	11 55	-51.0	152.9	-11.5		62	
		-39.0	164.9	+16.0	9		
		-27.5	176.4	+11.5	154		
		+12.0	215.9	-0.5		46	
		+28.0	231.9	+9.0	15		
		+74.0	277.9	+8.5		247	533

Positions and areas of sun spots—Continued

Date	Eastern standard civil time	Heliographic			Area		Total area for each day
		Diff. long.	Longi- tude	Lati- tude	Spot	Group	
1929—Continued							
Jan. 7 (Naval Observa- tory).	A. M. 11 52	° -36.0 -27.5 -14.5 +4.5 +25.5 +38.5	° 154.8 163.3 176.3 195.3 216.3 229.3	° -11.5 +18.0 +11.5 +11.5 -1.0 +10.0		93 77 139 46 108 108	571
Jan. 8 (Naval Observa- tory).	11 50	-81.5 -22.5 -14.0 -1.5 +17.5 +40.0 +53.5	96.1 155.1 163.6 176.1 195.1 217.6 231.1	+18.0 -11.5 +18.0 +12.0 +12.5 -1.0 +9.0	123	139 62 123 77 62 108	694
Jan. 9 (Naval Observa- tory).	10 56	-67.5 -9.5 +11.5 +30.5 +43.0 +52.5 +68.0	97.5 155.5 176.5 195.5 208.0 217.5 233.0	+18.0 -11.5 +11.5 +12.5 -12.0 -1.0 +8.5	123	62 108 62 31 77 108	571
Jan. 10 (Naval Observa- tory).	11 46	-56.0 -53.5 +3.0 +25.0 +42.0	95.3 97.8 154.3 176.3 193.3	-15.0 +18.0 -12.0 +12.0 +13.0		6 123 77 77 15	298
Jan. 11 (Naval Observa- tory).	12 27	-77.0 -39.5 -37.0 +17.5 +38.0	60.8 98.3 100.8 155.3 175.8	+7.5 +19.0 -15.0 -12.0 +12.0		201 77 15 62 46	401
Jan. 12 (Naval Observa- tory).	11 46	-63.0 -26.5 -24.5 -10.0 +21.5 +30.0 +51.5	62.0 98.5 100.5 115.0 146.5 155.0 176.5	+8.0 +19.5 -14.5 -7.5 -20.0 -12.0 +12.0		370 77 31 93 31 62 46	710
Jan. 13 (Naval Observa- tory).	11 41	-49.5 -13.0 -10.5 +4.5 +32.5 +43.0 +64.0	62.4 98.9 101.4 116.4 144.4 154.9 175.9	+7.5 +20.0 -14.5 -9.0 +5.0 -13.0 +12.0		509 123 31 108 28 9 6	814
Jan. 14 (Naval Observa- tory).	11 54	-35.0 0.0 +4.5 +16.5 +47.0	63.6 98.6 103.1 115.1 145.6	+6.5 +18.5 -15.0 -11.0 +3.5		494 62 31 216 46	849
Jan. 15 (Harvard)-----	14 2	-21.0 +15.0 +26.5 +32.5	63.0 99.0 110.5 116.5	+7.0 +20.0 -22.5 -10.0		857 164 181 376	1,578
Jan. 16 (Naval Observa- tory).	11 12	-72.0 -35.0 -10.0 +25.5 +36.5 +43.0	0.6 37.6 62.6 98.1 109.1 115.6	-11.0 +6.0 +7.5 +18.5 -22.5 -9.5		355 15 910 77 93 247	1,697
Jan. 18 (Naval Observa- tory).	14 51	-78.5 -40.0 +19.5 +54.0 +63.5 +69.5	325.8 4.3 63.8 98.3 107.8 113.8	+5.5 -10.5 +8.0 +20.0 -22.0 -9.5	15	401 679 31 31	1,188
Jan. 19 (Naval Observa- tory).	11 54	-67.0 -27.5 +31.5	325.8 5.3 64.3	+6.0 -10.0 +7.5		46 602 602	1,250
Jan. 20 (Naval Observa- tory).	11 41	-76.5 -55.0 -14.0 +45.5	303.2 324.7 5.7 65.2	+4.0 +5.5 -10.5 +7.5	77	170 432 463	1,142
Jan. 21 (Naval Observa- tory).	11 49	-68.5 -42.5 0.0 +58.0	298.0 324.0 6.5 64.5	+6.0 +5.5 -11.0 +7.5		355 201 370 370	1,296
Jan. 22 (Harvard)-----	11 42	-53.5 -28.5 +13.0 +73.0	300.0 325.0 6.5 66.5	+7.0 +8.0 -8.5 +8.5		542 329 450 423	1,744
Jan. 23 (Naval Observa- tory).	11 59	-43.0 -15.0 +27.5	297.0 325.0 7.5	+7.5 +6.5 -10.0		309 139 231	679
Jan. 24 (Harvard)-----	12 16	-28.5 -2.0 +42.0	298.5 325.0 9.0	+7.5 +6.5 -11.0		495 272 369	1,136
Jan. 25 (Mount Wilson)---	18 35	-12.0 -8.0 +15.0 +57.0	298.1 302.1 325.1 7.1	+10.0 +5.0 +5.0 -11.0		146 117 50 205	518

Positions and areas of sun spots—Continued

Date	Eastern standard civil time		Heliographic			Area		Total area for each day
			Diff. long.	Longi- tude	Lat- itude	Spot	Group	
1929—Continued								
Jan. 26 (Naval Observa- tory).	h. m.	°	°	°				
		—2.0	298.5	+8.0	-----	170	-----	
		+26.0	326.5	+5.5	-----	31	-----	
		+65.0	5.5	—11.0	-----	340	541	-----
Jan. 27 (Harvard) -----	13 10	+13.5	299.5	+8.0		124	-----	
		+28.0	314.0	+12.0	17	-----		
		+81.5	7.5	—10.0		710	851	-----
Jan. 28 (Naval Observa- tory).	12 12	+22.5	296.6	—22.0	12	-----		
		+26.0	300.1	+7.5		185	-----	
		+49.0	323.1	+6.5	15	-----	212	
Jan. 29 (Naval Observa- tory).	11 53	+40.0	301.1	+7.5		77	-----	
		+61.5	322.6	+6.0	15	-----	92	
Jan. 30 (Naval Observa- tory).	12 1	—7.5	240.4	—4.5		123	-----	
		+54.5	302.4	+8.0	77	-----	200	
Jan. 31 (Naval Observa- tory).	11 15	—71.0	164.1	+5.0	62	-----		
		+6.0	241.1	—5.0		154	-----	
		+67.0	302.1	+8.5	77	-----	293	
Mean daily area for January.								756

PROVISIONAL SUN-SPOT RELATIVE NUMBERS ¹ FOR JANUARY, 1929

[Data furnished through the courtesy of Prof. W. Brunner, University of Zurich, Switzerland]

January, 1929	Relative numbers	January, 1929	Relative numbers	January, 1929	Relative numbers
1		11	44	21	² 77
2		12	³ M 82	22	65
3	64	13	⁴ 82	23	102
4	66	14	⁴ 90	24	(⁴)
5	45	15	77	25	51 ?
6	³ E 39	16	113	26	(²)
7	61	17	(²)	27	55
8	⁴ 73	18	89	28	20
9	80	19	77	29	22
10	⁴ 74	20	92	30	³ M 29
				31	⁴ 31

Mean, 26 days, 65.4.

¹ Dependent alone on observations at Zurich University and its station at Arosa.² Passage of a large group through the central meridian.³ New formation of a larger or average-sized center of activity; E, on the eastern part of the sun's disk; M, near the central meridian.⁴ Passage of an average-sized group through the central meridian.

AEROLOGICAL OBSERVATIONS

By L. T. SAMUELS

Free-air temperatures for the month averaged below normal except at the eastern stations, Due West and Washington. (Table 1.) The negative departures were greatest at Ellendale where they were excessive but were successively smaller at the stations farther south.

Free-air relative humidities averaged above normal in many cases and particularly in the upper levels at Royal Center where the departures were unusually large. At this station and at Ellendale where negative temperature departures were greatest the total precipitation for the month exceeded all previous amounts for January. In this connection it is noted that the average vapor pressures in the higher levels at Royal Center were appreciably above normal notwithstanding the fact that the mean temperatures at the same levels were considerably below normal.

Table 2 shows the monthly resultant wind velocities to have been close to normal and the directions having in general a more northerly or less southerly component than normal.

It is interesting to note the Groesbeck kite record of the 27th in connection with the dissipation of a solid layer of stratus clouds over that station at 5:40 a. m. The balloon observation at that time showed the height of their base to be 500 meters and the wind at this elevation from the southwest. By 7:20 a. m. these clouds had dissipated and the kite observations showed the wind at 500 meters to be from the west although the surface wind continued from the southwest. This station was at the time in front of a wind shift line and it is evident that with the change in wind direction at the 500-meter level, dry air from a totally different source arrived and resulted in the dissipation of the clouds. The shift to northerly at the surface, however, did not occur until several hours later.

An interesting condition of snow flurries in a high-pressure area occurred at Royal Center on the 15th. The kite flight made during the occurrence of this precipitation revealed an inverted lapse rate from the ground to the cloud level at 500 meters, practically isothermal from the base to the top of the clouds at 850 meters, superimposed by another inversion layer to 1,850 meters. The occurrence of light snow flurries falling from air actually warmer than the air below it, is a result of the neighboring Great Lakes. These flurries form over the relatively warm water and later extend some distance beyond over the land which is considerably colder than the water.

TABLE 1.—Free-air temperatures, relative humidities, and vapor pressures during January, 1929

TEMPERATURE (° C.)

Altitude m. s. l.	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)		Washington, D. C. (7 meters)	
	Mean	De-parture from normal	Mean	De-parture from normal	Mean	De-parture from normal	Mean	De-parture from normal	Mean	De-parture from normal	Mean	De-parture from normal
Surface	0.0	—3.2	4.8	—0.9	—17.7	—6.6	8.4	+0.4	—8.5	—4.2	—1.6	—0.8
250	—0.1	—3.2	4.8	—0.8			8.0	+0.2	—8.6	—4.1	—1.8	—0.8
500	—1.0	—3.7	5.3	—0.1	—17.9	—6.9	7.2	—0.3	—9.9	—4.4	—2.3	—1.0
750	—1.1	—3.6	5.8	+0.7	—17.6	—7.4	6.8	—0.7	—10.3	—4.7	—2.7	—1.0
1,000	—0.1	—2.7	5.4	+0.9	—16.6	—7.8	6.5	—0.8	—9.6	—4.1	—3.5	—1.1
1,250	0.4	—2.2	4.7	+0.9	—15.9	—7.9	6.6	—0.4	—9.6	—4.0	—4.2	—1.1
1,500	0.3	—2.0	3.7	+0.8	—15.8	—7.7	6.0	—0.4	—9.8	—3.8	—4.3	—0.8
2,000	—0.6	—1.5	1.4	+0.4	—16.4	—6.8	4.7	0.0	—10.6	—3.6	—4.5	0.0
2,500	—2.6	—1.3	—0.9	+0.1	—17.8	—6.0	2.6	0.0	—11.9	—3.0	—5.5	+0.6
3,000	—4.9	—1.1	—2.9	+0.3	—19.9	—5.5	0.4	+0.1	—14.3	—3.1	—6.8	+1.1
3,500	—7.5	—1.1	—5.1	+0.3	—21.4	—4.2	—2.8	—0.3	—16.8	—3.1	—8.4	+1.4
4,000	—10.8	—1.5	—8.4	—0.1	—24.0	—4.2	—5.6	—0.3	—18.9	—3.6	—10.2	+1.4
4,500			—12.3	—1.1					—21.2	—3.4	—11.9	+1.4

RELATIVE HUMIDITY (%)

Surface	73	+3	73	+5	78	—3	75	—2	78	—3	66	—1
250	73	+3	72	+5			72	—3	78	—3	62	—2
500	71	+7	63	+2	77	—2	69	—2	75	0	59	—2
750	69	+9	57	—1	76	+4	67	0	70	0	57	—2
1,000	63	+8	55	—1	73	+7	60	—2	68	+1	56	—3
1,250	55	+5	54	0	71	+10	56	—1	65	+4	55	—3
1,500	49	+3	56	+4	71	+12	55	+1	67	+9	51	—5
2,000	44	+3	58	+9	67	+9	49	0	60	+7	47	—7
2,500	42	+2	57	+12	58	0	47	+1	66	+12	48	—5
3,000	40	0	58	+16	58	0	40	—2	74	+19	46	—7
3,500	42	+1	55	+16	50	—6	39	—1	79	+22	55	+1
4,000	44	+2	56	+15	45	—9	40	+2	79	+23	63	+1
4,500			57	+16					78	+23	73	+1

VAPOR PRESSURE (mb.)

Surface	4.67	—1.01	6.78	+0.03	1.26	—1.14	8.88	+0.02	2.57	—1.24	3.83	—0.33
250	4.63	—1.01	6.68	+0.01			8.38	—0.12	2.54	—1.19	3.56	—0.39
500	4.30	—0.76	6.09	—0.03	1.23	—1.12	7.54	—0.26	2.26	—1.05	3.26	—0.45
750	4.09	—0.51	5.72	—0.03	1.25	—0.95	7.04	—0.17	2.06	—0.97	3.08	—0.45
1,000	4.00	—0.20	5.36	—0.01	1.31	—0.84	6.22	—0.28	2.03	—0.76	2.84	—0.45
1,250	3.57	—0.21	4.90	0.00	1.35	—0.74	5.75	—0.08	2.02	—0.53	2.62	—0.44
1,500	3.12	—0.25	4.78	+0.36	1.36	—0.61	5.43	+0.20	2.01	—0.32	2.38	—0.47
2,000	2.53	—0.21	4.23	+0.61	1.24	—0.46	4.58	+0.40	1.71	—0.21	2.06	—0.38
2,500	2.04	—0.26	3.52	+0.74	0.98	—0.41	3.91	+0.54	1.80	+0.15	1.94	—0.16
3,000	1.65	—0.30	3.30	+1.11	0.84	—0.24	3.06	+0.40	1.70	+0.26	1.64	—0.15
3,500	1.56	—0.12	3.00	+1.33	0.69	—0.09	2.77	+0.65	1.66	+0.39	1.72	+0.11
4,000	1.45	+0.04	2.54	+1.12	0.64	+0.07	2.65	+0.91	1.60	+0.59	1.60	+0.11
4,500			2.09	+0.93					1.54	+0.71	1.55	+0.11

¹ Naval Air Station.